In the general control over many breeding places within the city which cannot be done away with, we have not been able to improve upon oil as a larvicide. The application of this oil, and usually it must be applied at approximately 7-day intervals, offers opportunity for development of methods and equipment which will bring the cost to a minimum. An example of this is perhaps in the catch basin control in the City of Washington. Over 10,000 trapped catch basins exist in which water is maintained at all times. In these catch basins we have found that Culex mosquitoes will breed in enormous quantities. Motorcycle equipment has been developed for carrying on this work. With this equipment it has been possible for one man to care for about 450 catch basins per day at a cost of approximately $.015 per catch basin oiling. Attempts have been made to develop other methods of control which would further reduce the cost. On the basis of $.40 to $.45 per season, however, it has thus far been difficult to lower the expense.

Another problem which was encountered in Washington and which might be encountered in other cities, particularly those located on navigable waters, is the hydraulic filling of marsh areas. In the filling operation, constantly changing water areas are created and generally the filled area is so soft that men cannot enter upon it. These areas may be controlled with the minimum amount of expense through spraying a water and oil mixture by means of a force pump installed in a bateau. With this apparatus it is possible to throw a stream of water mixed with oil a distance of 60 ft. from the end of a 500 ft. hose.

These two methods of applying oil in specific cases are given as illustrations of what may be developed to take care economically of certain breeding areas, which may be peculiar to any area.

Mosquito nuisance in a large urban area is due principally to causes brought about through the development of the city, and to the character of the city, and have little connection with conditions existent prior to development. Since conditions permitting the nuisance are man-made, the control should be considered as much a part of municipal activities as is garbage collection, for instance. Since mosquito nuisance is no more excusable than other nuisances, there should be no reason for permitting its existence.

INDUSTRIAL HYGIENE

The Influence of Atmospheric Ionization Upon the Human Organism—The physiologic effect of the ionic content of the air on the normal human organism was investigated in this study. Observations made on five normal subjects once a week over a period of 1 year showed no significant changes in the metabolic rate, blood pressure, pulse rate, respiration, oral, skin and body temperature, although under certain conditions, changes in atmospheric ionization appeared to be associated with minor physiologic changes.

Breathing artificially de-ionized air for a period of 1 hour has no apparent effect on a subject under basal conditions.—A. D. Brandt. *J. Indust. Hyg.* 15, 5:354–361 (Sept.), 1933. L. G.

The Effect of Clothing on the Rate of Cooling of the Body—This is a theoretical discussion of the effect

of clothing on the rate of cooling of the body. The naked and clothed body in still and moving air is considered, and formulae for the rate of cooling are developed in each case.

Analyses of the derived expressions show the following: A given air motion cannot cause as large a percentage increase in cooling on the clothed body as on the naked body; a greater increase in the cooling rate may be had by the removal of clothing than by an increase in air velocity when the over-all conduction of the clothing is less than the air flow coefficient for still air; and the rate of cooling of either a clothed or naked body, under constant conditions regarding clothing and air motion, is proportional to the difference between the skin temperature and the dry bulb temperature of the air.—Walter S. Weeks. *J. Indust. Hyg.* 15, 5:383–386 (Sept.), 1933. L. G.

Measurement of the Flow of Air Through Registers and Grilles—This study develops a method of measurement of air flow by the use of the anemometer which is applicable to field tests where a precision of 5 per cent may be considered reasonable. Several types of grille are considered in the investigation. Pitot tube traverses were taken as a basis of comparison of the method used.

The formula $V = \frac{C_v v(A+a)}{Z}$ (Where V = volume of air in cu. ft. per minute; C_v = velocity coefficient varying between 0.952 at 150 ft. per minute to 1.000 at velocity of 800 ft. per minute, v = average indicated velocity in ft. per minute obtained by anemometer traverse, A = gross area or grille in sq. ft.; a = net free area in sq. ft.) was found to be applicable under normal conditions and procedure for supply grilles, but a second coefficient was necessary when the frets of the grilles were large. The value of the fret coefficient, C_f, varies between 0.65 to 1.00 and is a function of the percentage of free area, size of fret and size of anemometer used.

The four methods of making an anemometer traverse, namely, (1) spot traverse—stationary reading; (2) over-all moving traverse; (3) spot traverse—moving reading; and (4) strip traverse, are discussed. With proper care all the methods gave substantially the same results.

The effect of approach on the character of the air stream is considered. Narrow strips of dead space may usually be ignored without appreciable error in the results but it is recommended that the quiescent area be omitted in the calculations of air flow.

Difficulty was encountered in velocity measurements of unit ventilators due to poor air distribution. A new method of measurement was therefore devised using a sheet-metal cone-cylinder attachment on the anemometers so as to obtain a uniform velocity against the whole area of the anemometer. This device is also applicable to the measurement of air flow in grilles of a highly ornamental pattern where it is difficult to measure accurately the free area of the outlet.

The disadvantage of this instrument is that it is sensitive to variations in the angle of flow. It is believed that the accuracy of the device may be increased by further developments.—L. E. Davies. *Heating, Piping and Air Conditioning*, 5, 9:486–495 (Sept.), 1933. L. G.

Radiation of Energy Through Glass—This is a study of low temperature radiation through glass. The absorbing qualities of various kinds of glass was determined with the pyroheliometer. Several radiant energy sources such as a radiant heater, an electric arc and banks of incandescent tungsten and carbon filament bulbs were used.

The results of the investigation showed that glass does not transmit low temperature radiation. Ordinary double strength window glass transmits no measurable amount of energy radiated from a source at 500° F., or lower. Only 6.0 and 12.3 per cent of the total radiation is transmitted from surfaces of 700° F. and 1,000° F. respectively. The same glass, however, transmits 76.3 per cent of the radiation from an incandescent tungsten lamp, 65.7 per cent of the radiation from an arc lamp and 88.9 per cent of the radiation from the sun. Glass windows may therefore constitute heat traps since they allow a relatively free transmission of radiant energy into the room from the sun to warm the objects in it, but do not allow these objects to lose this heat by re-radiation through the windows.—J. E. Blackshaw and F. C. Houghten. *Heating, Piping and Air Conditioning*, 5, 10:523–525 (Oct.), 1933. L. G.

On the Normal Absorption and Excretion of Lead. I. Lead Absorption and Excretion in Primitive Life—The presence of "normal" lead in human tissues has been a subject of controversy since 1838, but with improved methods for the estimation of lead it is now apparent that lead occurs regularly in the feces and in the urine, as well as in the tissues of normal, healthy persons. It was generally believed that the presence of lead in the normal body arose from contact with lead-containing commodities of modern life. Observations were therefore made in two communities in Mexico to test this hypothesis. The two chosen communities prescribed no opportunities for artificial lead exposure and represented conditions of primitive life. The only metal implements used consisted of sickles and machetes.

Blood, feces, and urine samples were taken from each of the 95 subjects selected for study. Beverages and food, as well as soil samples from the pueblos, were also analyzed. The results showed that the soil samples from various parts of the fields under cultivation yielded lead in concentrations between 0.60 to 6.00 mg. per kg.; water contained minute traces of lead; vegetation disclosed small amounts ranging from 0.03 to 0.94 mg. per kg.; lead in animal products and prepared food materials varied between 0.02 to 4.15 mg. per kg. The lead-glazed character of the pottery used may possibly account for the high concentration of lead in the prepared food. Urine analyses showed the mean concentration of lead to be 0.0138 mg. per liter of urine. The mean concentration of lead in the feces was 0.1078 mg. per sample of feces or 0.0347 mg. per gm. of ash. Blood analyses showed small amounts of lead. Sixty-five per cent of the blood samples were negative for lead content while 35 per cent showed concentrations from 0.01 to 0.06 mg. of lead per 100 gm. of blood.

A detailed description of the analytical methods used in the analysis of urine, feces, food, tissue and other materials is given.—Robert A. Kehoe, Frederick Thamann, and Jacob Cholak. *J. Indust. Hyg.* XV, 5:257–271 (Sept.), 1933. L. G.

On the Normal Absorption and Excretion of Lead. II. Lead Absorption and Lead Excretion in Modern American Life—This is a study of the lead intake and output of human subjects under normal environmental conditions. The results showed that the lead intake in the food of the selected subjects was approximately equivalent to the lead content of their feces and varied between 0.16 mg. to 0.28 mg. of lead per day; that the normal American adult excreted lead at a rate of from 0.02 to 0.08 mg. per liter of urine, and from 0.03 to 0.1 mg.

per gm. of ash in the feces; that the greater part of the lead administered orally was eliminated unabsorbed and that such amounts of lead which were absorbed produced an increase in the rate of urinary excretion during the period of active absorption and for a time thereafter.

Lead determination of the various tissues of the human body was also made. In the case of a normal child the greatest concentration of lead (1.142 and 1.022 of lead per 100 gm.) was found in the long and flat bone. The average lead concentration was 0.309 mg. per 100 gm. of tissue. The analysis of the tissues of a normal adult showed the greatest concentration (1.11 mg. of lead per 100 gm.) in the flat bone and an average lead concentration of 0.17 mg. per 100 gm. of tissue.—Robert Kehoe, Frederick Thamann, and Jacob Cholak. *J. Indust. Hyg.* 15, 5:273–288 (Sept.), 1933.

L. G.

On the Normal Absorption and Excretion of Lead. III. The Sources of Normal Lead Absorption—Previous studies have shown that the presence of lead in food materials was the major factor in the lead absorption and lead excretion of normal persons. Certain common foods and beverages were therefore analyzed for lead content. It was found that food which was largely of natural origin contained insignificant amounts of lead (0.00 to 0.11 mg. of lead per kg.) while the staple articles furnished large amounts of lead. It was found that fruits which were analyzed without removing the peel showed a high concentration of lead, the source obviously being from the wide use of lead compounds as insecticides.

On the basis of the amount of material consumed by an individual per week, meat and bread furnished one-fourth to one-third of the average amount of lead ingested weekly. When milk occupied a prominent position in the dietary it was found that it contributed a large proportion of lead. The concentration of lead in milk, however, did at no time exceed 0.04 mg. per liter.

Beverages, other than water, showed significant concentrations of lead. Synthetic lemonade, carbonated drinks, grape juice, and alcoholic beverages showed the presence of varying amounts of lead which were due to some form of contamination and not to the lead content of the beverage, *per se.*

An excellent bibliography on the sources of lead is presented.—Robert Kehoe, Frederick Thamann, and Jacob Cholak. *J. Indust. Hyg.* 15, 5:290–300 (Sept.), 1933. L. G.

On the Normal Absorption and Excretion of Lead. IV. Lead Absorption and Excretion in Infants and Children—In order to determine whether limited length and variety of experience was associated with a corresponding limitation of lead absorption and excretion, studies were made on a group of infants and children. A group of American children with no lead exposure showed a much higher concentration of lead in the urine and feces than a group of Mexican children living under essentially primitive conditions. The American group showed concentrations varying from 0.02 to 0.18 mg. per liter of urine, with a mean excretion of 0.08 mg. per liter, as compared with the Mexican group which varied from nil to 0.03 mg. per liter; with a mean of 0.015 mg. per liter. The mean lead excretion in the feces of the American group was twice that of the Mexicans, with 0.08 mg. per gm. of ash. No correlation was found between lead excretion and age.

Analyses of human milk from normal mothers with negative histories of occupational lead exposure showed that

ingestion of human milk is one source of lead intake. Amounts varying from 1.0 to 0.05 mg. per liter were found.

In order to test the possibility of the presence of lead in infants being due to lead absorption in utero, the tissues of premature and stillborn fetuses were analyzed for lead content. Varying amounts of lead were found in the various tissues but the amounts found were too small to account for a rate of lead excretion such as that observed in infants and children.—Robert A. Kehoe, Frederick Thamann and Jacob Cholak. *J. Indust. Hyg.* 15, 5:301–305 (Sept.), 1933. L. G.

Lead Absorption in Relation to the Diagnosis of Lead Poisoning—In recent years the presence of lead in the feces and urine of suspected cases of lead poisoning has been used as one of the criteria of lead exposure. The assumption was that an exposure to lead resulted in lead absorption and produced an elevated rate of lead excretion for some time after exposure had ceased. The lead excretion of subjects after cessation of lead exposure was therefore followed to determine the validity of such an assumption.

In the present study it was found that after cessation of lead exposure, lead is excreted at a higher rate than normal when abnormal amounts of lead are absorbed. The period of increased lead excretion depends upon the extent of lead absorption; the rate of lead output diminishes rapidly for a period of several weeks after which there is a prolonged and gradual diminution in the excretory rate until the normal level is reached. Following an abnormal lead exposure unusual amounts of lead were found in the blood during life and in the tissues at necropsy for variable periods of time after cessation of exposure.

The detection of abnormally high rates of lead excretion is a very valuable aid in determining the severity of lead exposure, but it does not constitute a diagnosis of lead intoxication. Skill and judgment in the interpretation of clinical evidence is still the basis of the diagnosis.—Robert A. Kehoe, Frederick Thamann and Jacob Cholak.—*J. Indust. Hyg.* 15, 5, 320–340 (Sept.), 1933. L. G.

Health Aspects of Radium Dial Painting. I. Scope and Findings—This report is the result of investigations conducted in the radium dial painting industry. This report consists of findings and recommendations. Seven factories were studied; 14 men and 228 women were examined. In the analysis the female radium workers were divided into two groups, one group consisted of workers who were exposed to radioactive substances before pointing the brush with the mouth was prohibited in every plant and the second group contained those workers who have been exposed to radium only under the new conditions. The results of the study indicated that the abolition of pointing the brush with the mouth has not entirely solved the problem of radium deposition in the body.

Tests demonstrated the presence of radioactive substances in the air of the workrooms. An average of 9.8×10^{-19} gm. of radium per 10 cu. m. of air was detected. The average gamma exposure of the workers was equivalent to that which would be produced by about 1 mm. of radium 50 cm. from a worker.

Twenty-eight recommendations are made for minimizing the hazard in radium dial painting. These suggestions pertain to factory cleanliness, personal cleanliness of the workers, protection of workers by means of screens and hoods, and adequate ventilation.—Louis Schwartz, Fred L. Knowles, Rollo H. Britton and Lewis R. Thompson.—*J. Indust. Hyg.* 15, 5:363–367 (Sept.), 1933. L. G.

Lead Absorption and Excretion in Certain Trades—This investigation consists of the study of lead excretion of workers in manufacturing plants when lead is involved. The results may be tabulated as follows:

	Degree of Exposure	*Mean Lead Concentration in Milligrams*		
		White Lead Mfg. plant	*Elec. Storage Battery plant*	*Tetraethyl Lead Mfg. plant*
Feces (per gram Ash)	Severe Exposure	0.870	0.70	0.201
	Moderate "		0.52	
	Mild "		0.22	
	Average "	0.573	0.45	0.186
Urine (per liter)	Severe Exposure	0.336	0.330	0.198
	Moderate "		0.176	
	Mild "		0.124	
	Average "	0.241	0.182	0.129

Clinical lead poisoning was observed in the white lead manufacturing plant and in the storage battery plant, while the tetraethyl lead plant had no such histories during a 5-year period of observation.

The rate of urinary lead excretion varies with the rate of lead absorption in normal persons without occupational lead exposure but increased exposure fails to bring about a corresponding increase in the urinary excretory rate. It is believed that lead exposure is safe if the mean lead excretion is not more than 0.6 mg. per day in the feces and 0.15 mg. per liter in the urine. If conditions are such that lead is excreted at a mean rate above 1.1 mg. per day in the feces and 0.21 mg. per liter in the urine, cases of lead poisoning may be expected to occur among exposed workers.—Robert A. Kehoe, Frederick Thamann and Jacob Cholak. *J. Indust. Hyg.* 15, 5:306–319 (Sept.), 1933.

L. G.

Health Aspects of Radium Dial Painting. II. Occupational Environment—The occupational environment of radium dial painting is discussed in this paper. This includes a history of the radium dial processes; a description and analysis of the occupation; and a sanitary survey of 7 radium dial painting plants.

Radioactive dust determinations were made by taking atmospheric dust samples in paper thimbles as a collecting medium at a rate of 2 cu. ft. per minute. The analyses showed an average exposure of 26.1×10^{-10} gm. of radium per 10 cu. m. of air for dial painters as compared to 9.8×10^{-10} gm. per 10 cu. m. of air for the general air of the room. The occupation of radium dusting gave the highest average concentration of 169.3×10^{-10} gm. per 10 cu. m. Considerable variations in the average radium exposure were noted in different plants for the same occupation.

Electroscopic determinations of the amounts of gamma and beta radiations and of radon were also made. The gamma radiation was found to be equivalent to the discharge produced by about 1,200 micrograms of radium 50 cm. from the instrument and the beta equivalent was 2,100 micrograms of radium. The radon readings gave an average of 51 curies $\times 10^{-8}$ per 10 cu. m. of air which was about 2,000 times the content of normal outdoor air.—J. J. Bloomfield and F. L. Knowles. *J. Indust. Hyg.*, 15, 5:368–382 (Sept.), 1933. L. G.